Lessons Learned from resolving massive IPS database change for SPADES+

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1. Introduction

Safety Parameter Display and Evaluation System+ (SPADES+) was implemented to meet the requirements for Safety Parameter Display System (SPDS) which are related to TMI Action Plan requirements. SPADES+ presents the information of critical parameters so that the operator is able to determine the plant status[1]. SPADES+ monitors continuously the critical safety function during normal, abnormal, and emergency operation mode and generates the alarm output to the alarm server when the tolerance related to safety functions are not satisfied. The alarm algorithm for critical safety function is performed in the NSSS Application Software (NAPS) server of the Information Process System (IPS) and the calculation result will be displayed on the flat panel display (FPD) of the IPS.

SPADES+ provides the critical variable to the control room operators to aid them in rapidly and reliable determining the safety status of the plant[2].

2. Methods and Results

In this section some of the techniques to resolve the massive IPS database change are introduced.

2.1 Problem

SPADES+ is one of IPS programs and uses about 1,500 points from IPS database. Each database point has the primary key (called as "POINT_ID" in IPS database) to discriminate between points.

When SPADES+ program is uploaded on the test equipment at other related company, KEPCO E&C found that the POINT_IDs of 518 points used for SPADES+ were changed according to the database revision. Because of the change of POINT_IDs, KEPCO E&C should change computer source codes and engineering documents.

At first, KEPCO E&C started to change the previous POINT_IDs to the latest POINT_IDs manually. But it resulted in several types of editorial errors as editing was in progress. So KEPCO E&C gave up this way and conceived an optimal way.

After all, KEPCO E&C has been developed the computerized solution which changes POINT_IDs automatically so that it can reduce man power and avoid human errors.

2.2 Program source code change tool

SPADES+ program is comprised of server program code and display code for Graphic User Interface (GUI).

Server program code is written in C++ language and display code is written in ILOG language. Because both codes are in ASCII format, program source code change tool was implemented with visual C++ studio.

Changed POINT_IDs were arranged as before and after columns in the list. These were used as the input for the program source code change tool.
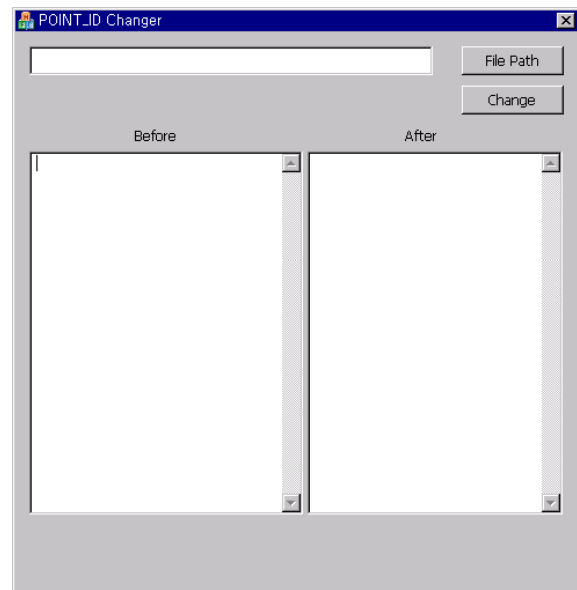

Fig. 1. The program code that should be changed is assigned with "File Path" button. The previous POINT_IDs are listed on the "Before" text box and the latest POINT_IDs are listed on the "After" text box. According to the Before and After text box contents, program code is changed by this program automatically.

2.3 Engineering document change with MS Word Macro

According to Software Program Plan, SPADES+ should be documented into Software Requirement Specification (SRS) and Software Design Specification (SDS) describing the POINT_IDs used for SPADES+. These documents were written by Microsoft Word that is able to use Macro function. To correct engineering documents, Microsoft Word Macro function was used. The previous and latest POINT_ID list was edited and endorsed in this Microsoft Visual Basic Macro. The changed parts should be written in blue and italic font in the engineering documents according to internal rule. Following Macro is able to change the revised part to

the blue and italic font. Fig. 2 shows the body part of Macro.

```
For Index = 1 To 518
    Selection.Find.ClearFormatting
    Selection.Find.Replacement.ClearFormatting
    With Selection.Find.Replacement.Font
        .Italic = True
        .Color = wdColorBlue
    End With
    With Selection.Find
        .Text = OldPID(Index)
        .Replacement.Text = NewPID(Index)
        .Forward = True
        .Wrap = wdFindContinue
        .Format = True
        .MatchCase = False
        .MatchWholeWord = False
        .MatchByte = False
        .CorrectHangulEndings = True
        .HanjaPhoneticHangul = False
        .MatchWildcards = False
        .MatchSoundsLike = False
        .MatchAllWordForms = False
    End With
    Selection.Find.Execute Replace:=wdReplaceAll
Next
End Sub
```

Fig. 2. Visual Basic Macro body that changes the previous POINT_IDs into the latest POINT_IDs. The changed parts of document should be the blue and italic font according to internal rule in the KEPCO E&C. Above Macro changed the changed parts to the blue and italic font. The previous Point ID names are assigned into the OldPid arrays, the new Point ID names are assigned into the NewPID arrays at the header of Macro. The two arrays are skipped because of the limited page.

2.4 Graphic database change

SPADES+ program is one of application programs in IPS. IPS has the Point database that includes almost all data for the plant. SPADES+ uses IPS database to calculate SPADES+ logics. To express IPS database information on FPD as symbol, another database is needed such as Graphic database. The Graphic database is necessary to express field sensor information dynamically on IPS display. Because Graphic database endorses the POINT_ID of the Point database, Graphic database should be updated with the new Point IDs. Graphic database file is a kind of ASCII text file that is delimited by comma (","). It's called as cvs (Comma-separated Values) file. It is able to be opened in MS Excel. The endorsed Point IDs of Graphic database also can be changed using MS Excel Macro. Though Graphic database is updated with MS Excel Macro, there is a possibility that MS Excel file includes additional information. So it is used as a reference to confirm to know the parts that should be corrected. Graphic database is edited with text editor manually.
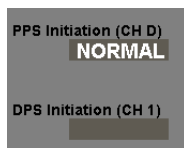

Fig. 3. Graphic database is necessary to express the value according to the predefined symbol schema. If Graphic database has a wrong POINT_ID, the value for the POINT_ID doesn't express. If the POINT_ID is not right in Graphic database, the value doesn't display like the second value of Fig. 3.

3. Conclusions

Many database point ID names (518 points) were changed. POINT_ID is used in the programming source code, the related documents such as SDS and SRS, and Graphic database.

To reduce human errors, computer program and office program's Macro are used. Though the automatic methods are used for changing POINT_IDs, it takes lots of time to resolve for editing the change list except for making computerized solutions.

In IPS, there are many more programs than SPADES+ and over 30,000 POINT_IDs are in IPS database. Changing POINT_IDs could be a burden to software engineers.

In case of Ovation system database, there is the Alias field to prevent this kind of problem. The Alias is a kind of secondary key in database.(POINT_ID is a primary in viewpoint of database.) As Alias file name is unique, it can be used like the primary key in programming source code and engineering document.

Though POINT_ID names are changed according to database policy, there is no effect in programming source code and engineering documents.

KEPCO E&C is trying to add this field in database at the next project.

Point Name	PN	NP-EI0109
System ID	ID	800049EDH
Point Alias	PA	NPE0037
Point Description	ED	N-1E 13.8KV SW01M BUS VOLT
Characteristic	KR	--------
Originating Drop Number	DO	200
Record Type	RT	91 (LA) Analog
Frequency		SLOW
Point Version Number	VN	78064

Fig. 4. Ovation system database has the Point Alias filed used instead of Point Name (equal to POINT_ID) in computer program source code because it is a unique key in database. Though Point Name is changed, it doesn't influence that computer program finds the database point. Moreover it is not necessary to revise the engineering documents related to computer program.

REFERENCES

[1] NUREG-0737, Supplement 1, Clarification of TMI Action Plan Requirements : Requirements for Emergency Response Capability, January 1983.
[2] NUREG-0696, Functional Criteria for Emergency Response Facilities, February 1981.